

CLAIMS

What is Claimed is:

- 5 1. A pumping apparatus for pumping fluid comprising:
 - at least one pumping chamber having an inlet and an outlet, said pumping chamber having a piston for movement in said chamber which piston propels said fluid from said chamber, said inlet for receiving fluid from a fluid supply and said outlet for discharging said fluid from said chamber;
 - at least one motor for powering said piston in said pumping chamber, said motor operating in pumping mode upon receiving a pumping signal;
 - 15 at least one inlet valve in fluid communication with said inlet of said pumping chamber, said inlet valve having an open position and a closed position;
 - at least one switchable valve in fluid communication with said outlet of said pumping chamber, said at least one switchable valve having a closed position and an open position, and said at least one switchable valve assuming said closed position upon receiving a close signal;
 - 25 at least one first pressure measuring device in fluid communication with said pumping chamber, between said inlet valve and switchable valve, said at least one pressure measuring device producing a pressure signal in response to pressure;
 - control means for receiving said pressure signal, for sending a close signal to said at least one switchable valve and for sending a pumping signal to said motor, said control means having a test mode in which said control means send a pumping signal to said motor, sends a close signal to said switchable valve to cause said fluid in said chamber to be placed under a pressure, said first pressure measuring device determining a first threshold pressure at a first time and sending a first threshold pressure signal to said control means, said first pressure measuring device determining at least one second

threshold pressure at a second time and sending a second threshold pressure signal to said control means, said control means calculating the slope of a line representing the difference of said first threshold pressure signal and said second threshold pressure signal over time and comparing said slope with a threshold value, said threshold value representing a leak in the pump, said control means sending one or more error messages to the operator in response to said slope exceeding said threshold value.

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2. The apparatus of claim 1 further comprising a check valve interposed in fluid communication between said at least one pump chamber and said switchable valve.

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3. The apparatus of claim 1 wherein said apparatus has a start up mode in which said control means is turned on and said control means engages said test mode upon start up to test for leaks.

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4. The apparatus of claim 1 further comprising two pump chambers said pump chambers comprising a first pump chamber and a second pump chamber said first pump chamber and second pump chamber in series with said first pump chamber receiving fluid from a fluid supply and in fluid communication with said second chamber to discharge said fluid to said second chamber, and at least one check valve interposed in fluid communication with said first pump chamber and said second pump chamber.

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5. The apparatus of claim 4 further comprising two motors, a first motor mechanically linked to said first pump chamber and a second motor mechanically linked to said second pump chamber, wherein in said test mode said control means sends a signal to said first motor and second motor.

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6. The apparatus of claim 5 wherein in said test mode said control means sends a pumping signal to said second motor, sends a close signal to said switchable valve to cause said fluid in said second chamber to be placed under a pressure, said first pressure measuring device determining a first threshold pressure at a first time and sending a first threshold pressure signal to said control means, said first pressure measuring device determining at least one second threshold pressure at a second time and sending a second threshold pressure signal to said control means, said control means calculating the slope of a line

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representing the difference of said first threshold pressure signal and said second threshold pressure signal over time and comparing said slope with a threshold value, said threshold value representing a leak in the pump, said control means sending one or more error messages to the operator in response to said slope exceeding said threshold value

5 indicating one or more leaks in said check valve or said pump apparatus in fluid communication with the second pump chamber under pressure.

7. The apparatus of claim 5 wherein in said test mode said control means sends a pumping signal to said first motor, sends a close signal to said switchable valve to cause said fluid

10 in said first chamber to be placed under a pressure, said first pressure measuring device determining a first threshold pressure at a first time and sending a first pressure signal to said control means, said first pressure measuring device determining at least one second threshold pressure at a second time and sending a second threshold pressure signal to said control means, said control means calculating the slope of a line representing the

15 difference of said first threshold pressure signal and said second threshold pressure signal over time and comparing said slope with a threshold value, said threshold value representing a leak in the pump, said control means sending one or more error messages to the operator in response to said slope exceeding said threshold value indicating one or more leaks in said inlet valve or said pump apparatus in fluid communication with the first

20 pump chamber under pressure.

8. The apparatus of claim 4 further comprising a second pressure measuring device

interposed in fluid communication between said first pump chamber and said check valve, wherein in said test mode said control means sends a pumping signal to said first motor, to

25 cause said fluid in said first chamber to be placed under a pressure, said second pressure measuring device determining a first threshold pressure at a first time and sending a first threshold pressure signal to said control means, said second pressure measuring device determining at least one second threshold pressure at a second time and sending a second threshold pressure signal to said control means, said control means calculating the slope of

30 a line representing the difference of said first pressure signal and said second pressure signal over time and comparing said slope with a threshold value, said threshold value representing a leak in the pump, said control means sending one or more error messages to the operator in response to said slope exceeding said threshold value indicating one or

more leaks in said inlet valve or check valve or said pump apparatus in fluid communication with the first pump chamber under pressure.

9. The apparatus of claim 8 wherein said control means sends a close signal to said switchable valve, and said control means receives a first set of pressure values from said first pressure measuring device and a second set of pressure values from said second pressure measuring device and compares said values to determine errors in the performance of said pressure measuring devices or leaks in the apparatus.
10. The apparatus of claim 1 further comprising two pump chambers, two inlet valves and two outlet valves, said pump chambers comprising a first pump chamber and a second pump chamber said first pump chamber and second pump chamber in parallel with said first pump chamber receiving fluid from a fluid supply via a first inlet valve and said second pump chamber receiving fluid from a fluid supply via a second inlet valve, said first pumping chamber discharging said fluid via a first outlet check valve and said second pumping chamber discharging said fluid via a second outlet check valve, said first outlet check valve and said second outlet check valve in fluid communication with said switchable valve.
11. The apparatus of claim 10 further comprising two pressure measuring devices and two motors, said motors comprising a first motor mechanically linked to said first pump chamber and a second motor mechanically linked to said second pump chamber, said two pressure measuring devices comprising a first pressure measuring device and a second pressure measuring device, said first pressure measuring device interposed in fluid communication between said first pumping chamber and said first check valve and said second pressure measuring device interposed in fluid communication between said second pumping chamber and said second check valve, to allow said first pump chamber and said second pump chamber to be placed in test mode independent of each other.
12. The apparatus of claim 11 wherein in said test mode said control means directs one of said motors to go into pumping mode which places one of said first or second pump chamber under pressure and such apparatus in fluid communication with said pump

chamber under pressure through said opposite check valve, to allow testing of the outlet check valve of the opposite pump chamber.

13. The apparatus of claim 12 wherein in said test mode first one motor of on pump
5 chamber is placed in pump mode and then the opposite motor of the opposite pump chamber is placed in pump mode to allow testing of the two outlet check valves.

14. The apparatus of claim 11 wherein said control means sends a close signal to said outlet valve, and said control means receives a first set of pressure values from said first 10 pressure measuring device and a second set of pressure values from said second pressure measuring device and compares said values to determine errors in the performance of at least one of the following components selected from the group consisting of said pressure measuring devices, said first or second pump chambers, said first and second inlet valves and said outlet check valve.

15. A method of testing the performance of a pumping apparatus for pumping fluid comprising:

20 at least one pumping chamber having an inlet and an outlet, said pumping chamber having a piston for movement in said chamber which piston propels said fluid from said chamber, said inlet for receiving fluid from a fluid supply and said outlet for discharging said fluid from said chamber;

25 at least one motor for powering said piston in said pumping chamber, said motor operating in pumping mode upon receiving a pumping signal;

at least one inlet valve in fluid communication with said inlet of said pumping chamber, said inlet valve having an open position and a closed position;

30 at least one switchable valve in fluid communication with said outlet of said pumping chamber, said at least one switchable valve having a closed position and an open position, and said at least one switchable valve assuming said closed position upon receiving a close signal;

at least one first pressure measuring device in fluid communication with said pumping chamber, between said inlet valve and switchable valve, said at least one pressure measuring device producing a pressure signal in response to pressure;

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control means for receiving said pressure signal, for sending a close signal to said at least one switchable valve and for sending a pumping signal to said motor, said control means having a test mode in which said control means send a pumping signal to said motor, sends a close signal to said switchable valve to cause said fluid in said chamber to 10 be placed under a pressure, said first pressure measuring device determining a first threshold pressure at a first time and sending a first threshold pressure signal to said control means, said first pressure measuring device determining at least one second threshold pressure at a second time and sending a second threshold pressure signal to said control means, said control means calculating the slope of a line representing the 15 difference of said first pressure signal and said second pressure signal over time and comparing said slope with a threshold value, said threshold value representing a leak in the pump, said control means sending one or more error messages to the operator in response to said slope exceeding said threshold value; said method comprising the steps of operating said apparatus in test mode.

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16. The method of claim 15 wherein said apparatus further comprises a check valve interposed in fluid communication between said at least one pump chamber and said switchable valve.

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17. The method of claim 15 wherein said apparatus has a start up mode in which said control means are turned on and said control means engage said test mode upon start up to test for leaks.

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18. The method of claim 15 wherein said apparatus further comprises two pump chambers said pump chambers comprising a first pump chamber and a second pump chamber said first pump chamber and second pump chamber in series with said first pump chamber receiving fluid from a fluid supply and in fluid communication with said second chamber

to discharge said fluid to said second chamber, and at least one check valve interposed in fluid communication with said first pump chamber and said second pump chamber.

19. The method of claim 15 wherein said apparatus further comprising two motors, a first
5 motor mechanically linked to said first pump chamber and a second motor mechanically linked to said second pump chamber, wherein in said test mode said control means sends a signal to said first motor and second motor.

20. The method of claim 19 wherein in said test mode said control means sends a pumping signal to said second motor, sends a close signal to said switchable valve to cause said fluid in said second chamber to be placed under a pressure, said first pressure measuring device determining a first threshold pressure at a first time and sending a first threshold pressure signal to said control means, said first pressure measuring device determining at least one second threshold pressure at a second time and sending a second threshold pressure signal to said control means, said control means calculating the slope of a line representing the difference of said first threshold pressure signal and said second threshold pressure signal over time and comparing said slope with a threshold value, said threshold value representing a leak in the pump, said control means sending one or more error messages to the operator in response to said slope exceeding said threshold value
15 indicating one or more leaks in said check valve or said pump apparatus in fluid communication with the second pump chamber under pressure.

21. The apparatus of claim 19 wherein in said test mode said control means sends a pumping signal to said first motor, sends a close signal to said switchable valve to cause said fluid in said first chamber to be placed under a pressure, said first pressure measuring device determining a first threshold pressure at a first time and sending a first threshold pressure signal to said control means, said first pressure measuring device determining at least one second threshold pressure at a second time and sending a second pressure signal to said control means, said control means calculating the slope of a line representing the difference of said first threshold pressure signal and said second threshold pressure signal over time and comparing said slope with a threshold value, said threshold value representing a leak in the pump, said control means sending one or more error messages to the operator in response to said slope exceeding said threshold value indicating one or
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more leaks in said inlet valve or said pump apparatus in fluid communication with the first pump chamber under pressure.

22. The method of claim 18 further wherein said apparatus further comprises a second pressure measuring device interposed in fluid communication between said first pump chamber and said check valve, wherein in said test mode said control means sends a pumping signal to said first motor, to cause said fluid in said first chamber to be placed under a pressure, said second pressure measuring device determining a first threshold pressure at a first time and sending a first threshold pressure signal to said control means, said second pressure measuring device determining at least one second threshold pressure at a second time and sending a second threshold pressure signal to said control means, said control means calculating the slope of a line representing the difference of said first threshold pressure signal and said second threshold pressure signal over time and comparing said slope with a threshold value, said threshold value representing a leak in the pump, said control means sending one or more error messages to the operator in response to said slope exceeding said threshold value indicating one or more leaks in said inlet valve or check valve or said pump apparatus in fluid communication with the first pump chamber under pressure.
23. The method of claim 22 wherein said control means sends a close signal to said switchable valve, and said control means receives a first set of pressure values from said first pressure measuring device and a second set of pressure values from said second pressure measuring device and compares said values to determine errors in the performance of said pressure measuring devices or leaks in the apparatus.
24. The method of claim 15 wherein said apparatus further comprises two pump chambers, two inlet valves and two outlet valves, said pump chambers comprising a first pump chamber and a second pump chamber said first pump chamber and second pump chamber in parallel with said first pump chamber receiving fluid from a fluid supply via a first inlet valve and said second pump chamber receiving fluid from a fluid supply via a second inlet valve, said first pumping chamber discharging said fluid via a first outlet check valve and said second pumping chamber discharging said fluid via a second outlet

check valve, said first outlet check valve and said second outlet check valve in fluid communication with said switchable valve.

25. The method of claim 24 wherein said apparatus further comprising two pressure measuring devices and two motors, said motors comprising a first motor mechanically linked to said first pump chamber and a second motor mechanically linked to said second pump chamber, said two pressure measuring devices comprising a first pressure measuring device and a second pressure measuring device, said first pressure measuring device interposed in fluid communication between said first pumping chamber and said first check valve and said second pressure measuring device interposed in fluid communication between said second pumping chamber and said second check valve, to allow said first pump chamber and said second pump chamber to be placed in test mode independent of each other.
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- 15 26. The method of claim 25 wherein in said test mode said control means directs one of said motors to go into pumping mode which places one of said first or second pump chamber under pressure and such apparatus in fluid communication with said pump chamber under pressure through said opposite check valve, to allow testing of the outlet check valve of the opposite pump chamber.
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27. The method of claim 26 wherein in said test mode first one motor of on pump chamber is placed in pump mode and then the opposite motor of the opposite pump chamber is placed in pump mode to allow testing of the two outlet check valves.
- 25 28. The method of claim 27 wherein said control means sends a close signal to said outlet valve, and said control means receives a first set of pressure values from said first pressure measuring device and a second set of pressure values from said second pressure measuring device and compares said values to determine errors in the performance of at least one of the following components selected from the group consisting of said pressure measuring devices, said first or second pump chambers, said first and second inlet valves and said outlet check valve.
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29. A pumping apparatus for pumping fluid comprising:

at least one pumping chamber having an inlet and an outlet, said pumping chamber having a piston for movement in said chamber which piston propels said fluid from said chamber, said inlet for receiving fluid from a fluid supply and said outlet for discharging said fluid from said chamber;

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at least one motor for powering said piston in said pumping chamber, said motor operating in pumping mode upon receiving a pumping signal;

10 at least one inlet valve in fluid communication with said inlet of said pumping chamber, said inlet valve having an open position and a closed position;

15 at least one switchable valve in fluid communication with said outlet of said pumping chamber, said at least one switchable valve having a closed position and an open position, and said at least one switchable valve assuming said closed position upon receiving a close signal;

20 at least one first pressure measuring device in fluid communication with said pumping chamber, between said inlet valve and switchable valve, said at least one pressure measuring device producing a pressure signal in response to pressure;

25 control means for receiving said pressure signal, for sending a close signal to said at least one switchable valve and for sending a pumping signal to said motor, said control means having a test mode in which said control means send a pumping signal to said motor, sends a close signal to said switchable valve to cause said fluid in said chamber to be placed under a pressure, said first pressure measuring device determining a minimal pressure and sending a minimal pressure signal to said control means, said control means comparing said first pressure signal to minimal acceptable value, said minimal acceptable value representing a defect in the pump, said control means sending one or more error messages to the operator in response to said first pressure signal failing to attain said minimal acceptable value.

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30. The apparatus of claim 29 further comprising a check valve interposed in fluid communication between said at least one pump chamber and said switchable valve.
- 5 31. The apparatus of claim 29 wherein said apparatus has a start up mode in which said control means is turned on and said control means engages said test mode upon start up to test for defects.
- 10 32. The apparatus of claim 29 further comprising two pump chambers said pump chambers comprising a first pump chamber and a second pump chamber said first pump chamber and second pump chamber in series with said first pump chamber receiving fluid from a fluid supply and in fluid communication with said second chamber to discharge said fluid to said second chamber, and at least one check valve interposed in fluid communication with said first pump chamber and said second pump chamber.
- 15 33. The apparatus of claim 32 further comprising two motors, a first motor mechanically linked to said first pump chamber and a second motor mechanically linked to said second pump chamber, wherein in said test mode said control means sends a signal to said first motor and second motor.
- 20 34. The apparatus of claim 33 wherein in said test mode said control means sends a pumping signal to said second motor, sends a close signal to said switchable valve to cause said fluid in said second chamber to be placed under a pressure, said first pressure measuring device determining a minimal pressure and sending a minimal pressure signal to said control means, said control means comparing said minimal pressure signal to minimal acceptable value, said minimal acceptable value representing a defect in the pump, said control means sending one or more error messages to the operator in response to said first pressure signal failing to attain said minimal acceptable value.
- 25 35. The apparatus of claim 33 wherein in said test mode said control means sends a pumping signal to said first motor, sends a close signal to said switchable valve to cause said fluid in said first chamber to be placed under a pressure, said first pressure measuring device determining a minimal pressure and sending a minimal pressure signal to said control means, said control means comparing said minimal pressure signal to minimal

acceptable value, said minimal acceptable value representing a defect in the pump, said control means sending one or more error messages to the operator in response to said first pressure signal failing to attain said minimal acceptable value.

5 36. The apparatus of claim 32 further comprising a second pressure measuring device interposed in fluid communication between said first pump chamber and said check valve, wherein in said test mode said control means sends a pumping signal to said first motor, to cause said fluid in said first chamber to be placed under a pressure, said second pressure measuring device determining a minimal pressure and sending a minimal pressure signal to said control means, said control means comparing said minimal pressure signal to minimal acceptable value, said minimal acceptable value representing a defect in the pump, said control means sending one or more error messages to the operator in response to said first pressure signal failing to attain said minimal acceptable value.

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15 37. The apparatus of claim 36 wherein said control means sends a close signal to said switchable valve, and said control means receives a first set of pressure values from said first pressure measuring device and a second set of pressure values from said second pressure measuring device and compares said values to determine defects in the apparatus.

20 38. The apparatus of claim 29 further comprising two pump chambers, two inlet valves and two outlet valves, said pump chambers comprising a first pump chamber and a second pump chamber said first pump chamber and second pump chamber in parallel with said first pump chamber receiving fluid from a fluid supply via a first inlet valve and said second pump chamber receiving fluid from a fluid supply via a second inlet valve, said first pumping chamber discharging said fluid via a first outlet check valve and said second pumping chamber discharging said fluid via a second outlet check valve, said first outlet check valve and said second outlet check valve in fluid communication with said switchable valve.

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30 39. The apparatus of claim 38 further comprising two pressure measuring devices and two motors, said motors comprising a first motor mechanically linked to said first pump chamber and a second motor mechanically linked to said second pump chamber, said two pressure measuring devices comprising a first pressure measuring device and a second

pressure measuring device, said first pressure measuring device interposed in fluid communication between said first pumping chamber and said first check valve and said second pressure measuring device interposed in fluid communication between said second pumping chamber and said second check valve, to allow said first pump chamber and said 5 second pump chamber to be placed in test mode independent of each other.

40. The apparatus of claim 39 wherein in said test mode said control means directs one of said motors to go into pumping mode which places one of said first or second pump chamber under pressure and such apparatus in fluid communication with said pump

10 chamber under pressure through said opposite check valve, to allow testing of the outlet check valve of the opposite pump chamber.

41. The apparatus of claim 40 wherein in said test mode first one motor of on pump chamber is placed in pump mode and then the opposite motor of the opposite pump

15 chamber is placed in pump mode to allow testing of the two outlet check valves.

42. The apparatus of claim 40 wherein said control means sends a close signal to said outlet valve, and said control means receives a first set of pressure values from said first pressure measuring device and a second set of pressure values from said second pressure

20 measuring device and compares said values to determine defects in the apparatus.

43. A method of testing the performance of a pumping apparatus for pumping fluid comprising:

25 at least one pumping chamber having an inlet and an outlet, said pumping chamber having a piston for movement in said chamber which piston propels said fluid from said chamber, said inlet for receiving fluid from a fluid supply and said outlet for discharging said fluid from said chamber;

30 at least one motor for powering said piston in said pumping chamber, said motor operating in pumping mode upon receiving a pumping signal;

at least one inlet valve in fluid communication with said inlet of said pumping chamber, said inlet valve having an open position and a closed position;

5 at least one switchable valve in fluid communication with said outlet of said pumping chamber, said at least one switchable valve having a closed position and an open position, and said at least one switchable valve assuming said closed position upon receiving a close signal;

10 at least one first pressure measuring device in fluid communication with said pumping chamber, between said inlet valve and switchable valve, said at least one pressure measuring device producing a pressure signal in response to pressure;

15 control means for receiving said pressure signal, for sending a close signal to said at least one switchable valve and for sending a pumping signal to said motor, said control means having a test mode in which said control means send a pumping signal to said motor, sends a close signal to said switchable valve to cause said fluid in said chamber to be placed under a pressure, said first pressure measuring device determining a minimal pressure and sending a minimal pressure signal to said control means, said control means comparing said minimal pressure signal to a minimal acceptable value, said minimal acceptable value representing a defect in the pump, said control means sending one or more error messages to the operator in response to said first pressure signal failing to attain said minimal acceptable value.

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44. The method of claim 43 wherein said apparatus further comprises a check valve 25 interposed in fluid communication between said at least one pump chamber and said switchable valve.

45. The method of claim 43 wherein said apparatus has a start up mode in which said control means is turned on and said control means engages said test mode upon start up to 30 test for defects.

46. The method of claim 43 wherein said apparatus further comprises two pump chambers said pump chambers comprising a first pump chamber and a second pump chamber said

first pump chamber and second pump chamber in series with said first pump chamber receiving fluid from a fluid supply and in fluid communication with said second chamber to discharge said fluid to said second chamber, and at least one check valve interposed in fluid communication with said first pump chamber and said second pump chamber.

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47. The method of claim 43 wherein said apparatus further comprising two motors, a first motor mechanically linked to said first pump chamber and a second motor mechanically linked to said second pump chamber, wherein in said test mode said control means sends a signal to said first motor and second motor.

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48. The method of claim 47 wherein in said test mode said control means sends a pumping signal to said second motor, sends a close signal to said switchable valve to cause said fluid in said second chamber to be placed under a pressure, said first pressure measuring device determining a minimal pressure and sending a minimal pressure signal

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to said control means, said control means comparing said minimal pressure signal to minimal acceptable value, said minimal acceptable value representing a defect in the pump, said control means sending one or more error messages to the operator in response to said first pressure signal failing to attain said minimal acceptable value.

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49. The apparatus of claim 47 wherein in said test mode said control means sends a pumping signal to said first motor, sends a close signal to said switchable valve to cause said fluid in said first chamber to be placed under a pressure, said first pressure measuring device determining a minimal pressure at a first time and sending a minimal pressure signal to said control means, said control means comparing said minimal pressure signal to minimal acceptable value, said minimal acceptable value representing a defect in the pump, said control means sending one or more error messages to the operator in response to said first pressure signal failing to attain said minimal acceptable value.

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50. The method of claim 46 further wherein said apparatus further comprises a second pressure measuring device interposed in fluid communication between said first pump chamber and said check valve, wherein in said test mode said control means sends a pumping signal to said first motor, to cause said fluid in said first chamber to be placed under a pressure, said second pressure measuring device determining a minimal pressure

and sending a minimal pressure signal to said control means, said control means
comparing said first pressure signal to minimal acceptable value, said minimal acceptable
value representing a defect in the pump, said control means sending one or more error
messages to the operator in response to said first pressure signal failing to attain said
5 minimal acceptable value.

10 51. The method of claim 50 wherein said control means sends a close signal to said
switchable valve, and said control means receives a first set of pressure values from said
first pressure measuring device and a second set of pressure values from said second
pressure measuring device and compares said values to determine defects in the apparatus.

15 52. The method of claim 43 wherein said apparatus further comprises two pump
chambers, two inlet valves and two outlet valves, said pump chambers comprising a first
pump chamber and a second pump chamber said first pump chamber and second pump
chamber in parallel with said first pump chamber receiving fluid from a fluid supply via a
first inlet valve and said second pump chamber receiving fluid from a fluid supply via a
second inlet valve, said first pumping chamber discharging said fluid via a first outlet
check valve and said second pumping chamber discharging said fluid via a second outlet
check valve, said first outlet check valve and said second outlet check valve in fluid
20 communication with said switchable valve.

25 53. The method of claim 52 wherein said apparatus further comprising two pressure
measuring devices and two motors, said motors comprising a first motor mechanically
linked to said first pump chamber and a second motor mechanically linked to said second
pump chamber, said two pressure measuring devices comprising a first pressure measuring
device and a second pressure measuring device, said first pressure measuring device
interposed in fluid communication between said first pumping chamber and said first
check valve and said second pressure measuring device interposed in fluid communication
between said second pumping chamber and said second check valve, to allow said first
30 pump chamber and said second pump chamber to be placed in test mode independent of
each other.

54. The method of claim 53 wherein in said test mode said control means directs one of said motors to go into pumping mode which places one of said first or second pump chamber under pressure and such apparatus in fluid communication with said pump chamber under pressure through said opposite check valve, to allow testing of the outlet 5 check valve of the opposite pump chamber.

55. The method of claim 54 wherein in said test mode first one motor of on pump chamber is placed in pump mode and then the opposite motor of the opposite pump chamber is placed in pump mode to allow testing of the two outlet check valves.

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56. The method of claim 55 wherein said control means sends a close signal to said outlet valve, and said control means receives a first set of pressure values from said first pressure measuring device and a second set of pressure values from said second pressure measuring device and compares said values to determine defects.

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